

September 1, 1958

Aviation Week

Including Space Technology

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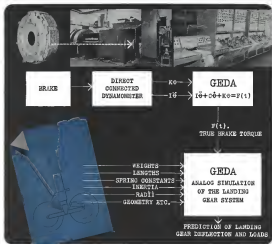
Thanks to yesterday's pioneering, Brunswick today produces man-made structures of simple and compound configuration by the unique Bricfil and B Process. Continuous and costly research and development work permits the precision placement of juxtaposed fibers in numbers and orientation prescribed by the stress analysis.

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How Goodyear determines a vibration-free landing-gear system
—while the aircraft is still on "the boards!"

It's common knowledge that modern day aircraft designers are turning to higher-strength alloys in landing gear systems in order to save weight.

And it's known too that landing gears made from these high-strength alloys are more flexible. But when it is not known, in advance, what the behavior of these components will be under actual loading conditions—whether vibrations will reach such amplitudes as to cause early fatigue, stress or other structural problems, or in any way be unacceptable when the airplane is finally done.

To determine this behavior, Goodyear engineers have applied the principles of vibration dynamics, and together with an elaborate laboratory setup, Goodyear can now simulate a complete

landing-gear system to predict the compatibility of all components before the gear has been built.

Testing the proposed parts with a large direct-drive dynamometer and an impedance loopup of GEDA Analog Computers, Goodyear can accurately ascertain the response of the landing-gear system to the loads—can investigate any desirable modification while the system is still on "the boards."

The technology in solving costly problems not only for production, but for complex work or "logic" type gears as well—as great savings in time and engineering man-hours. It is an example of how Goodyear serves its customers with advanced techniques as well as the latest hardware. For information, write: Goodyear, Aircraft Products Division, Dept. L1476, Akron 16, Ohio.

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Circle 10, Reader Service Card, June 12, 1966

to supplement your systems' engineering!

HOW MAGNESIUM ALLOY SAND CASTINGS IMPROVE AIRCRAFT DESIGN

New thin-wall castings replace complex, costly fabrications

Thin-walled magnesium alloy sand castings used in aircraft and missile assemblies is growing by leaps and bounds. One reason is the general recognition among designers that magnesium saves precious weight without sacrificing strength and rigidity. Two other reasons are also responsible for the rapid increase in the use of magnesium castings in aircraft design.

1. New elevated-temperature alloys.
2. Rugged design, construction characteristics of magnesium sand castings.

Many alloy systems are now commonly used for magnesium sand castings—magnesium-aluminum-zinc, magnesium-copper-zinc and magnesium-thorium.

Mg-Al-Zn alloys have high strength and very good casting characteristics. They provide stability of properties up to 300°F and often are satisfactory at high as 500°F. A number of different alloys in this system are available, each having a characteristic combination of properties—yield strength, tensile strength, ductility, weldability, etc. In addition, these alloys are heat-treatable to obtain a range of strengths.

For the 500°F-500°F range, the magnesium-copper-zinc alloy can be

used. These alloys have excellent pressure tightness as well as good creep strength at temperature and can also be heat-treated.

For temperatures up to 500°F, the magnesium-thorium alloys are used. H133A is particularly good for short time elevated-temperature uses where high stresses are encountered. H233A is excellent for low stress performance over a long period of time. Both have creep characteristics superior to the Mg-Al-Zn and Mg-copper-zinc alloys, and both are available in the heat-treated condition.

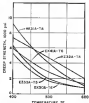
Magnesium alloy sand castings are being made in a large variety of shapes and sizes, ranging from a few ounces to over 1000 lbs. The favorable casting characteristics of magnesium in general permit unusual flexibility in design.

Thin-walled sections, for example, can be produced to replace intricate fabrications involving several operations. Although thin walls are not really large walls in size, new techniques have been developed to obtain large thin-walled sections with better than average surface uniformity.

For more information about magnesium sand castings and their use in aircraft design, contact your nearest magnesium branch or Dow metal office.



TYPICAL THIN-WALL magnesium casting used in a missile control surface.



CREEP STRENGTH of magnesium-zinc-zinc and magnesium-thorium alloys—0.2% total extension for 1000 hours.

MAGNESIUM DESIGN, a 222-page handbook, discusses all phases in detail: properties, structural design, product design, including castings and mill products, fabrication and finishing. Large sections of tables on properties, stress, tolerances, etc. For your copy contact a Dow metal office or write to: NEW DESIGN DIVISION, Midland, Michigan, Department 44041111.



YOU CAN DEPEND ON



AVIATION CALENDAR

- Sept. 1-7-1955: Washington Flying Display and Exhibition, Society of British Aircraft Constructors, Washington, D.C.
- Sept. 6-Annular Meeting, co-sponsored by General Electric Small Aircraft Engine Dept. and American Helicopter Society, Contract C. J. Tison General Electric Co., 3400 Western Ave., Los Angeles.
- Sept. 8-10-First International Congress of the Aeronautical Sciences, Palace Hotel, Madrid, Spain.
- Sept. 11-12-Annual Business Meeting and Conference, Northeast Chapter, American Assn. of Airport Executives, Monroeville Airport, Pittsburgh, Pa.
- Sept. 13-14-15-Annual American Rocket Society, Inc. (AARS) Meeting, Dayton, Ohio.
- Sept. 15-16-Annual Industrial Automation Conference & Exhibit (International), in association with Society of American Philadelphians, Philadelphia Convention Hall, Philadelphia, Pa.
- Sept. 17-18-19-Annual Convention of the National Association of Manufacturers, National Hotel, Philadelphia, Pa.
- Sept. 20-21-22-Annual Meeting, Professional Group on Technology and Research, Central American Hotel, San Antonio, Texas.
- Sept. 23-24-25-Annual Meeting, Western Flight, Western Helicopter Society, Anaheim Hotel, Los Angeles, Calif.
- Sept. 26-27-28-Annual Meeting, Western Flight, Western Helicopter Society, Anaheim Hotel, Los Angeles, Calif.
- Sept. 29-30-31-Annual Meeting, Western Flight, Western Helicopter Society, Anaheim Hotel, Los Angeles, Calif.
- (Continued on page 6)

AVIATION WEEK Includes Space Technology

September 5, 1955
Vol. 47, No. 9

AVIATION WEEK includes Space Technology, September 5, 1955. Vol. 47, No. 9. This issue contains a special section on Space Technology, featuring articles on the development of the Saturn rocket, the design of the Apollo spacecraft, and the progress of the Gemini program. The main body of the issue covers a wide range of aviation topics, including the latest developments in jet engines, aircraft design, and flight testing. The issue is a valuable resource for anyone interested in the field of aviation and space exploration.

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HIGH-PRESSURE TYPE 4-800 is offered in differential and gage models from 600 to 10,000 psi, and absolute models from 600 to 1000 psi. Design features include construction of 203 stainless steel, fatigue zone that takes 10,000 psi, nitrogen resistance to more than 21 g/s in a 2" x 2" x 1/2" package.

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AVIATION CALENDAR

(Continued from page 5)

- Sept. 28-Oct. 3—National Aeronautical Meeting, Society of Automotive Engineers, Inc., the Automobile, Los Angeles, Calif.
- Sept. 29-Oct. 3—Annual Meeting and Western Trade Show, American Society of Tool Engineers, Shreve Exposition Hall, Los Angeles, Calif.
- Oct. 13—Conference on Radio Interference Reduction, sponsored by American Radio Manufacturers and U. S. Army Signal Engineering Laboratories, University of Science and Industry, Chicago, Ill.
- Oct. 13—National Aeronautics Conference, University of California, Santa Ana, California, sponsored by American Association of Engineers and the CAA.
- Oct. 4—Annual Aeronautics Society of Experimental Test Pilots, Fort Hays Hotel, Riverside, Calif.
- Oct. 6—National Symposium on Extended Range and Space Transportation, sponsored by Institute of Radio Engineers and George Washington University, Lincoln Auditorium, Washington, D. C.
- Oct. 7-10—Joint Meeting, Institute of the Aeronautical Sciences and Canadian Aeronautical Institute, Chateau Laurier, Ottawa, Canada.
- Oct. 8-14—4th Annual Aviation Space Plug and Broken Conference, Chapman Space Plug Co., Santa Ana, Calif.
- Oct. 9-14—North American National Year Aerospace Symposium, sponsored by American Research Foundation, Hotel Sheraton, Chicago, Ill.
- Oct. 14-16—NORTH EAST Joint Information Conference, Sheraton Hotel, Los Angeles, Calif.
- Oct. 18-19—10th Annual National Electronics Conference, Hotel Sheraton, Chicago, Ill.
- Oct. 14—Airport Development 4 Operations Conference, New York Sheraton Hotel of Convention, George Washington University, N. Y.
- Oct. 15-17—Twelfth Annual National Southwestern Airport Manager's Association, El Paso Sheraton Hotel, El Paso, Texas.
- Oct. 20-21—Florida National Aero-Gas Symposium, sponsored by Institute of Radio Engineers, Hotel Udon, Udon, N. Y.
- Oct. 20-22—1969 Annual Meeting, Air of the United States Army, Marston Park Hotel, Washington, D. C.
- Oct. 22-24—20th National Vacuum Symposium, sponsored by Institute of Radio Engineers, Sheraton Hotel, Dallas, Texas.
- Oct. 20-22—1969 Annual Meeting, Air of the United States Army, Marston Park Hotel, Washington, D. C.
- Oct. 21-23—1969 National Electronics Conference, sponsored by Institute of Radio Engineers Professional Group on Electronic Computers, Sheraton Hotel, Dallas, Texas.
- Oct. 27-28—Annual General Meeting of the International Air Transport Association, New Delhi, India.
- Oct. 27-28—Joint Conference on Aeronautical & Spacecraft Electronics, Institute of Radio Engineers, Sheraton Hotel, Dallas, Texas.
- Oct. 30-31—1969 Flight Research Meeting, sponsored by Institute of Radio Engineers, Sheraton Hotel, Washington, D. C.

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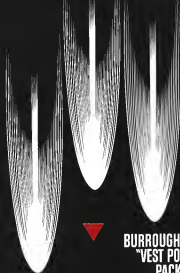
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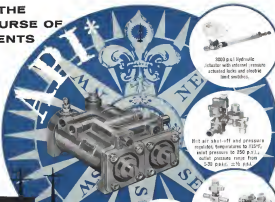
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lock up range, individual or
automatic adjustment, no leakage



EDITORIAL

The Problems Ahead

The aviation industry and its related technologies suffer lack for problems blossoming on their technical, economic and political horizons. The session of the 85th Congress terminated last month with an extremely rare accord of coming to grips with the fundamental problem of organizing a national policy coordinating all our efforts in this vital area.

It has been apparent to people in the industry for more than a decade that aviation and its related technologies reaching all the way into outer space are a keystone in the national strength of any nation. This includes the vast total of all aviation efforts, the airlines as well as military aviation and the expensive and increasingly complicated ground environment for these operations.

However, our political leaders have been extremely tardy in recognizing this fact. In contrast the top Soviet hierarchy grasped this fact long after World War II. They have given their aviation and scientific programs top priority. They have solidified this policy to increase international power and prestige. Their profits from this long top priority development program during the past few years have put the Soviet Union in a position where it is challenging the military strength and scientific leadership of the U.S.

Belatedly, Congress and the White House have become aware of the need for a truly national policy in this area. During this last session, this task body needed action to settle the confusion of bureaucracy and warring and conflicting authority that hamstringing is now applying to make necessary progress in maximum time. Similarly, both Congress and the White House recognize the vital role of aviation in our national economy, not only as a manufacturing industry but as an integral part of our transportation system.

However, much remains to be done to build on the sound foundation laid in the 85th Congress. There are some logical steps that the required action will be performing. One of the most acute problem facing both the military and the industry that builds their response in that of modernizing procurement policies and procedures so that the military, the industry and the taxpayer American public get a fair share.

The present mass of procurement legislation and ad-hoc legislative regulations were written basically to cover the buying of military ships and battleships. They are totally inadequate to handle the structures created by complex aircraft, missile and space vehicle systems that we now the prime requirement of the military. It is impossible to patch or amend the present legislative or regulatory mass to meet these modern requirements.

The job required a complete fresh start and an entirely new set of laws and regulations aimed at meeting modern requirements in a swift and expeditious manner. The legislation which Sen. Schweitzer of Massachusetts introduced in the closing days of the last Congress (AW Aug. 18, p. 26) is certainly a step in the right direction.

In this connection, we urge the aviation industry to shun its traditional air of detached indifference and get into the thick of the discussion on this legislation. The success of industry participation in the legislative process will be reflected by Boeing Aircraft Co. President William Allen was a good example of the constructive contribution that experienced industry leaders can make to vital legislation in this area. We have been pleased to note that the Aircraft Industries Assoc. under the leadership of Orval Cook has been taking an active and constructive interest in legislative issues.

One of the big points that must be hammered home to the Congress is the relative size of regulated and unregulated bid contracts. Even such a knowledgeable and experienced military legislator as Rep. Carl Vinson of Georgia doesn't appear to understand that weapons systems such as the B-70 bomber, Atlas missile and Dyna-Soar cannot possibly be handled by advertised formal bids. The regulated contract has become a mere word on Capitol Hill. But, under the present means of procurement policies and procedures, it is about the only way to handle any complexity at all can be developed and produced with reasonable speed.

Another congressional loophole that needs to be straightened out is the current emphasis in Capitol Hill toward the weapon system concept. The weapon system concept is the only feasible technical approach to developing modern, complex weapons. The old idea of buying a lot of components from individual manufacturers and then trying to squeeze them into an airplane or missile casing is a technical disaster today. The whole trend has healthily been toward an integrated system development team which actually includes as much small business and component development as others.

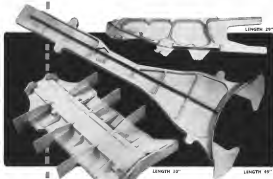
There may be some aspects of the economic handling of weapon system management that could stand much revision and improvement but from the technical viewpoint there is simply no other way to get the job done today.

And, of course, the competition policy needs a thorough overhaul. It makes absolutely no sense for one branch of the government to declare in "excess profits" the money earned from another branch under an anti-trust type contract that actually used money for the government. The aviation industry needs and wants some type of profit limitation legislation. This will protect the taxpayer public against profiteering on government contracts and will maintain its own reputation by ensuring that producers in its ranks or as its buyers will be treated out by government policy.

But the most vital of items urged by the aviation industry is so far below the average of American industry that it is presenting this group from accumulating sufficient working capital to make the tremendous investments in research and development now required to maintain the technical pace.

—Robert Hottel

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INDUSTRY OBSERVER

Avco is announcing mounting a dozen of several Vaguard third stage engines on a Vaguard intermediate stage turbine engine to form an advanced gas turbine. Two turbines are available—the solid Gasol Control Rocket Co. engine used in Vaguard keeps up to now or the parallel development by Allison Turbine Laboratory, which is used as a third stage in the Avco Power Turbine engine. Each engine has a thrust of approximately 2,500 lb.

Avco has plans for a 5,000-hp stage solid propellant turbine engine designed to the Avco as a follow-on project to its 1,100-hp Polaris first turbine engine. Like the Polaris, Avco probably will be fixed from intermediate turbines.

Avco is expected directly on choice of a contractor to develop world-wide Strategic Air Command Control System (SACCS). The intermediate stage processing system is intended to keep SAC command continuously posted on the current state of status and location of every strategic missile and bomber, including those in the air. SAC command now gets such information by conventional communication channels, making it several hours late.

Avco is expected to be a three-to-five helicopter engine, which is scheduled to be made in a small quantity. Competing companies are Bell, Kawasaki, McDonnell, Pratt & Whitney, and Sikorsky. Avco has been invited by Avco, to enter the competition but declined. Avco's engine involves using the T-100 turbine engine, which is a U.S. manufacturing right.

Avco will open competition this fall for an unmanned drone that can be launched from destroyers and other small ships for environmental work missions. Avco also probably will be required to have a certain amount of lift potential.

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SILICONES

Washington Roundup

Renegotiation Request Denied

Congress turned down the secretaries' request for the right to appeal U. S. Tax Court decisions on profit determination in the U. S. Court of Appeals (AW Aug. 4 p. 17) in extending the negotiation law to most jobs. Reasons given by the Joint Committee on Internal Revenue Taxation were:

- **Elimination of excessive profits**—work as an act of discretion; and should be made by the Tax Court.
- **Because it is in the executive branch of the government** and has the power to exercise administrative determination which are not of a judicial nature.
- **There is doubt as to whether the Court of Appeals** has authority to review decisions on profit determination.
- **Granting the right to appeal at the present time** places a premium on delay. Many contractors who have entered into voluntary settlements with the **Renegotiation Board** might not have done so had there been a right of appeal beyond the Tax Court.

Sen. Francis Case (R-S.D.), sponsor of the original **Renegotiation Act**, added: "Normal judicial review does not have the tax accommodations, the engineers and the standards for evaluating the various matters which enter into costs which the Tax Court has."

Federal Aviation Act Signed

Federal Aviation Act of 1958 creating an independent Federal Aviation Agency has been signed by President Eisenhower but the question as to who will be named to head the all-powerful group is still undecided. The field is now wide open with as many as 24 candidates rumored to be either going forward for the job or under serious consideration by the White House.

Most logical candidates, and the one who also has the strongest support from both aviation and Capitol Hill, is Presidential Aide Elwood Quesada.

Quesada, however, has declined to withdraw from the running unless there were no serious aviation advocates besides which he would be required to do under the provisions of the act.

A last-ditch effort on Capitol Hill is by supporters to obtain a modification of the act that would permit him to take the post and hold on to his retirement benefits and his position as aide to the President was turned too late to be successful. However, by increasing on the job as assistant to the President, Quesada will be in a strong position to guide and direct the negotiators of the agency in questions of aviation and airlines.

James C. Pille, Civil Aeronautics Administration, apparently now stands the best chance of getting the job but he will not rate preference in the White House in public opinion who are not overlooking the fact that the previous appointment is a choice spot in taxpayer's pocket.

Nuclear Test Suspension

Legislative suspension of U. S. nuclear weapons testing was made from the recent contract without significant that detection of bluffs is technically feasible. "without certain specific limits," plus the U. S. British offer to negotiate a suspension agreement with Russia. The resolution, however, is still full of it.

U. S. offer allows time for completion of Operation Hardtack, some plus the current British test areas and calls for suspension for one year if Russia accepts.

and does not require testing. Suspension would be reviewed from year to year if an inspection system were initiated and working, and if satisfactory results were being made toward overall arms control. Problems noted:

- **In spite of testing in the White House**, State Department and among some scientists that political and biological considerations outside the U. S. sphere, Pershing and Atomic Energy Commission still believe continued testing is essential.
- **Political factor**, absent from the meeting of scientific experts who assumed a high degree of accord over feasibility of detection, is certain to enter negotiators over inspection and control. Delays that they'll cause given Russia—which is less likely, concentrated than the U. S. to reduce weapons in its effort determined—there to continue building conventional armaments.
- **Some observers feel** that any great differences between Russia's agreement in principle to inspection and actual agreement that negotiators must be established on Soviet soil and inspection allowed in if necessary.
- **Question of whether Communist China** would allow inspection ports probably will be tied by the Communists to the question of U. S. recognition of its government.

Scientists who met last week at Geneva and concluded that even most small bluffs could be detected recommended that tests "should be dropped on constraints and on standards as well as on a few days in the ocean."

Duplication Defended

Panel of six scientists and education last week took issue with critics who oppose new duplication of effort within the defense establishment. Reporting to a congressional subcommittee on the navy's anti-submarine warfare inadequacies (see page 18), the panel noted:

"It should be obvious that multiple agencies in research are necessary and that at this stage more than one approach to the same question must be explored. Such apparent duplication is not wasted. On the contrary, five waste money from manufacturing ineffective weapons and from making progressively into the production of inadequately equipped and satisfied equipment."

Air Museum Approved

Smithsonian Institution has finally been given the green light by Congress to move forward with plans and specifications for construction of an Air Museum at an already selected site on southwest Washington. The Museum was first authorized in 1946.

Frontier Purchase

Congress has strong that the Civil Aeronautics Board will endorse a hearing examiner's recommendation that control of Frontier Airlines be given to Mervyn B. Mervyn. It is approved. Last week, Board Chairman Fred N. Jordan recommended that Mervyn be permitted to retain the 64% of Frontier's stock which he recently purchased and to become a member and chairman of the company's board of directors. Mervyn also controls the Mervyn Aircraft Corp. and International Airlines, both of which are engaged presently in rebuilding military aircraft in the U. S. and Europe.

—Washington staff

Soviet Missile Submarine Threat Detailed

Congressional scientific panel proposes radical steps to provide an adequate defense against submarines.

By Cecil Rowland

Washington-Soviet Union will be capable of mounting a "devastating carrier without attack" from the sea in the early 1980's which present is non-tolerated U. S. defense could not stop, "a special congressional panel of scientists and technicians warned last week. The panel proposed radical steps to counter the threat.

In a report to the Subcommittee on Military Applications of the Joint Committee on Atomic Energy, the six-member panel urged that Navy's research and development budget for anti-submarine warfare must be immediately doubled as an effort to find effective means of countering the Soviet threat. It would present funding in this field "grossly inadequate."

At present, the panel warned, "no weapons system, in fact, in fact, even on an experimental basis, offers an adequate defense against non-inhabiting submarines which are quiet and deep."

"It is very doubtful whether the present scale and scope of research and development in defense warfare will give us an effective defense against non-inhabiting submarines in time to meet the threat."

An attack by one Polaris-type ballistic missile submarine, the panel said, could devastate several of our cities. A cruise attack, with such weapons could form our entire urban system. Specific anti-submarine problems being

the Navy and the help it needs to secure from industry is increasing they were recently outlined by Aviation Week in a series of two articles (July 14, p. 52; July 21, p. 73).

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when forces both within the Navy and on Capitol Hill today are hurrying together to make a major push during the next session of Congress to release soft dollar funds to put the anti-submarine research and development program on what would amount to a wartime footing. Behind public recognition by Navy of its urgent need for improved anti-submarine technology and equipment since earlier this year in fact of knowledge that the Soviets will begin launching in the next future nuclear ballistic missile equipped submarines (AW July 14, p. 52).

The group also recommended that, "in a matter of national importance," the Navy's program for the Polaris threat to our nation's security be accelerated and that the budget be increased in order to the Navy's present and budget ceilings."

At present, they said, "Funds for anti-submarine Polaris-type submarines will come out of the Navy's regular shipbuilding budget. This appropriation covers the construction of carriers, cruisers, frigates, destroyers, tenders, mine sweepers and all other major vessels operated by our Navy."

"A Polaris-launching submarine is then treated like any other small boat. In terms of its military orders, however, it is radically different from other ships in the fleet. Actually, the Polaris system is part of our national military deterrent against attack was in a matter of strategic importance. It is more analogous to a B-57 bomber or a land-based ICBM or ICBM than to other ships of our Navy."

We recommend that construction

now budget requests for the Polaris system be determined by the Secretary of Defense and the National Security Council as part of our overall strategic defense budget."

Under present programming, the panel said, Navy now plans to have approximately 40 Polaris submarines in operation by 1975.

Constructive program for attack, submarines designed specifically to find and kill enemy submarines also should be accelerated the report said. Navy now plans to build about 10 advanced attack submarines during the decade 1960-70, which, in 1970 model provide a total force of 65 nuclear-powered attack submarines and approximately 10 diesel submarines.

"On this basis alone," the report said, "only 12 to 15 submarines could be on station in the Atlantic, with a matching force in the Pacific."

Research Need

Concerning the need for a sustained research and development push, the panel noted that "submarine research growth is both slow and irregular."

Consequently, it has failed to attract either the financial support or the people. For instance, the example can be seen in the lack of interest in oceanography, while research on underwater acoustics is almost the only source of government government laboratories. A lack of progress in construction of new facilities for oceanography and acoustics could bring even our weapons into the fold."

A second problem the panel said, "is the fact that much of the research and development means now available is directed by "small defense organizations in creating weapons systems and techniques." It added that although a certain proportion of the research budget is set aside for longer range research, not enough money is available in any one place at any one time to support truly bold and radical proposals requiring extensive new look here.

Critical Areas

The panel listed the "critically important" research and development programs which it said, "should be given priority over all others." They are:

- Underwater sound phenomena research. Intensive research in underwater sound is needed both to determine how much further improvement is possible in passive listening and to determine the possibilities and requirements for active (sonar) systems. Such research will require large hydrophone arrays with associated shore-based equipment and will also require research ships with extensive acoustic capabilities and submarine targets available on



DAUNTLESS - It is possible on long range. Although despite although helicopter can be adapted for depth charges. Under Navy plan, helicopter in close could be used in all stages only flying to the target area to release torpedoes or depth charges at a submarine which a surface vessel's search has detected and classified. Offshore vessels of surface would be to probing the underwater methods of present ASW surface vessels which can be substituted by faster surface submarines.



TSF-6032 is dropped from Alaska in evaluation test for Electronic Force, U. S. Atlantic Fleet. Other helicopters tested include those manufactured by Bell, Kaman and Gyronair.



SLD AVIATION release Alaska II, being manufactured by U. S. by Republic Aviation Corp., a model for tankless class. Navy destroyer class helicopter is being evaluated for anti-submarine warfare use, possibly as a close vision for all-weather operations.



Chance Vought F8U-2 Makes First Flight

First production Chance Vought F8U-2 Corsair jet flies outside Fort Rye, Aerovis is powered by advanced Pratt & Whitney J67 engines. External changes from F8U-1 include low aspect ratio wing and air on its fuselage and air scoop for different cooling.

Soviet Academy Oversees R&D Effort

New York—Soviet Russia's 390-year-old Academy of Sciences has been integrating and directing the nation's basic research and development effort since the 1930s, keeping the programs in line with Soviet political objectives, according to Rust Adas, John E. Clark, deputy director of Advanced Research Projects Agency.

The major role played by the academy in the conduct of Russia's affairs is a result of "a very profound difference between the status of the sciences in the two world cultures and in the Soviet Union," Adas. Clark said in a New York speech.

"The Soviets, in other words, attach enormous to the sciences of the West, regard the sciences as being fundamental rather than incidental to the entire cultural-social life of the nation," he said. "It is important for us to understand this feature if we are to understand where and how scientific development is being run or where it is going."

The academy is the largest scientific organization in the world, with a combined staff and membership of more than 20,000. Of these, 1,500 are technical workers and 600 of the 1,500 are full professors.

Despite "many serious struggles and the heavy hand of Soviet bureaucracy," these top scientists are responsible for making research and development programs showing great political use of the Soviet Union, Adas. Clark said. "In a machine-like structure, this yields has certain advantages," he said.

"Because of its prestige, its influence

and its position," Clark said, the academy has been able to "raise the social bar of the teachers, the scientists and the professional engineers to the very highest social status in the Soviet Union."

It "has insisted that most top scientists also teach science. If you are a scientist in a laboratory, you are generally also a part-time teacher in that laboratory or in a school," he said. Soviet colleges are graduating 10% more students per year now than the U.S., Clark said, but the great difference from the technological point of view is that 60 or 70% of the Soviet educational effort goes into scientific training, against less than 20% in the U.S.

Soviet Education

Clark, speaking on the subject of the missile and space age in education, reviewed these facts about Soviet education:

- Soviet aeronautical engineers graduate have the equivalent of a master's degree from Massachusetts Institute of Technology, according to MIT. "This put in much basic science and a great deal more specialization."
- Soviet scientists are "the only schools in the world that train their own engineers in serious engineering, management of aircraft production and economics of aircraft production."

- All Soviet engineering students must spend 25% to 27% of their training time, 25 to 35 weeks, with industry. During this time, they must solve three industrial problems that have arisen from their work in the design area

"This is an attempt to close the gap between the design area of work and the production area of work," Clark said. "Also due and one-half years of training (they) are able to go to work with industry or a private laboratory without any further on-the-job training."

- Education in support of research and development is carried out at four levels in Russia, Clark said.
- Primary level, where students and teachers are trained for the three services.
- High schools, where basic science is emphasized heavily.
- Colleges, polytechnical institutes and universities.
- Professional institutes and laboratories.

The university and college level is perhaps the most important in the research and development picture. Clark gave these figures on Russia's 790 institutions of higher learning:

- 266 are professional engineering schools, including 24 polytechnical institutes that compare to MIT in size and scope, and serve 10 scientific universities. In the U.S., 214 colleges teach engineering sciences in part of a broader curriculum.
- 34 are universities and 362 are non-scientific schools "as we have here for the training of leaders."

Screening of students in Russia has begun by the fifth year of elementary school. "There will be little promise of entering high school but with some specialized aptitude are drafted into military ser-

vice units and. They are trained for six to eight months as junior assistant mechanics in aircraft, radio, instruments, ammunition and electrical repair. Then they go in units to serve a minimum of two to three years.

As assistant mechanics, they are considered apprentices, and as such, will, on an overall emergency basis, serve their home country's needs but still are compelled to serve 30 to 45 days before turning duty a year with their senior units.

From 1928 to 1955, Russia graduated 198,000 more engineers than the U.S. While their training was not as good, the quality gap is closing "rather rapidly" and the growth rate is members of engineers will be fairly steep.

Technology and science in warfare have advanced so fast and far, and are advancing faster and faster, so that in an ideal way, be it limited—which is far more likely—on direct nuclear war, that only with the highest orders of technology and science in its wide full potential," Clark said.

Clark said that generally some of the problems of development, indigenous, as well as imported, and the other children. He said there are larger problems even than government support of education and increasing the attractiveness of the teaching profession, since the ends in a democracy must be achieved "by character building and not by indoctrination."

"In the age and in the future, power is built upon knowledge and the use of it by people depends on their education to work hard and sacrifice to acquire knowledge," Clark, and "This takes character."



Explorer V Instrument Package

Explorer V instrument package, similar to one used in Explorer IV, has been modified by University of Iowa scientists so that one of its two main instruments (sensors) will be sensitive to radiation dose in electrons. In this way, scientists hope to determine whether solar discharges cause radiation stress on electrons or protons (AW Aug. 16, p. 32).

New M.I.T. Unit Will Coordinate Air Forces' Air Defense Systems

Wilmington—Mits Corp., now now joint scientific organization that will serve as technical coordinator to Air Force on air defense policies and administration of an defense system, has been formed by Massachusetts Institute of Technology.

Mits (Massachusetts Institute of Technology, Research & Engineering) will provide scientific and engineering services to USAF's Air Defense Systems Integration Bureau similar to those provided to USAF's Ballistic Missile Division by Rand-Woods Research Technology Laboratories.

New news reports a desire to free scientists of M. I. T.'s Lincoln Laboratory who originally developed the SAGE air defense system, from current implementation and integration problems to allow them to return to their original mission of basic research and development in the field of an defense system.

H. Ballard Griffin Jr., named to head Mits' head of research headed the White House study of the Soviet Threat group which has his name (AW Dec. 2, p. 25) and in chairman of the Board of the Ford Foundation.

C. W. Halligan, named as Mits' president, comes from Bell Telephone Laboratories where he was director of military engineering.

Office for Mits will be located in Air Defense Systems Integration Bureau (ADSIB) building at 4. G. Howe

avenue, Bedford, Mass., site of the Air Force Cambridge Research Center and also is near Lincoln Laboratory. ADSIB is a command group—headed by Maj. Gen. Kenneth F. Bessert, of Air Research & Development Command—directs operations ARDC, Air National Command and Air Defense Command.

Personnel

Initial nucleus of Mits personnel will be drawn from Lincoln Laboratory, including a number of SAGE development with the remainder drawn from outside sources. Role of building will be discussed in Defense Department, M. I. T. press.

Field number of professional engineers and scientists is expected to reach 500 to 700, approximately the size of basic Technology Laboratories. Can host for 500 scientists has been awarded to cover the problem. As the new organization is able to take assigned responsibilities, Lincoln Laboratory will shift its efforts back to basic air defense research mission. Massachusetts Institute of Technology, which established Mits at Air Force request, expects to see all connections with the new organization once it has gotten on its way, a spokesman says.

Integration Problems

At the time SAGE was conceived and its development was begun, it was recognized as the most complex, electronic, computerized system ever attempted. Since that time, Air Force and Lincoln Laboratory scientists have learned that SAGE is only a small part of the problem and that the individual components of SAGE (SAGE, Radar, Radar, Radar) also must be fully integrated into the overall defense system.

The problem of integrating many individual weapons and electronic systems into a single system is a major problem, according to the Air Force, which is the USAF's Air Defense Systems Integration Bureau.

ADSIB has issued increasingly as Lincoln Laboratory scientists for technical assistance in solving these integration problems and in following paths have associated with implementation and improvements in the SAGE air defense system.

This division of research scientists from the rest of the Air Force is best equipped to handle and from the second instance which Massachusetts Institute of Technology, originally has planned to, had distributed some M. I. T. officials.



BOEING 707-120 seen at Los Angeles en route for Pan American training flight to Trans-World Airport, Baltimore

Modified 707 Starts PanAm Cargo Runs

By Gloria Garza

New York-Pan American World Airways first jet aircraft equipped with three engine modifications are in service on its prototype, arrived at Idlewild last week to begin a three-month test program for the inauguration of America's jet age.

The Boeing 707-120 is performing cargo and passenger flights from Idlewild and undergoing tests, checks by the Port of New York, New York. Officials in commercial service industry, but Pan American still is calling Nov. 1 its tentative inaugural target date. And if service could be started Oct. 28 to coincide with the airline's 11th anniversary, it is unlikely that the present launch advantage would be lost on Pan American officials.

Thrust Reversers

The production 120's Pratt & Whitney JT7 engines are fitted in addition to 22 take more engines, with three thrust reversers and, in addition, a wash air—40% reverse thrust. These devices are of climb and cruise configurations. They are not incorporated in Civil Aeronautics Administration certified landing distances.

Other two new modifications are leading edge flaps and nose gear extension to boost aircraft performance.

Pan American brought its new jet, delivered at Seattle Aug. 15, to Idlewild for a trial New York, San Jose revenue cargo operation and for crew training

flights. Operations are under strict limitations imposed by the Port of New York Authority (NY July 23, p. 30). That agency will monitor, as to the engine's acceptance from the standpoint of noise, had its associated environmental monitoring the test jet in test program.

After taking off the U. S. jet up with transatlantic service in November, the airline must handle several still problems.

•Port Authority permission to serve

New York, is expected, but possible weight limitations in other restrictions at Idlewild may hamper scheduled operations.

•Federal's Ministry of Transport and Civil Aviation said last week that provisional operational restrictions had been set for jet aircraft at London Airport, with the de Havilland Comet IV and Sud Aviation Caravelle equipped. Pan American plans to take its 707-120 to London for two days of ground tests there.



THURST reverser in nacelle and cascade design, reportedly provides up to 40% average thrust for F&W JT7 engine. Boeing is incorporating device in production airplanes



VORTEX generators are installed on each wing of 707-120 toward trailing edge. Devices improve wing planform stability.

•Crew complement was present the thrust of an engine between pilots and flight engineers, with the engine in the middle. Shows down has been avoided in the current situation by using supervisory-level engineers on the flights.

The 707-120, first American jet to be delivered to an airline and first jet to be converted by an American carrier, arrived at Idlewild Aug. 17 after a 7 hr. 24 min. flight from San Juan with 30 persons and 2,600 lb. of cargo aboard. Tailoff gross weight was 214,757 lb. and landing weight was 175,600 lb. There were all of the 3,100-lb. engines for its landing, although it could have shipped 2,600 lb. shorter if pilot Scott Pinner had wanted to use more fuel. The aircraft were to use a few seconds after touchdown.

Weight Limits

Operations is limited to 190,000 lb. gross takeoff weight from Idlewild to the Port Authority rules, and the plane must reach 1,500 ft. of altitude by the time it reaches commercial use. The airport. Flights are restricted to the higher limits. Pan American claims its own special takeoff maximum of 1,700 ft. for additional safety during the training operation. The cargo carrier to San Juan, scheduled to begin last November, was delivered by Seattle, jet under test conditions.

Two modifications are carrying additional capacity with maximum and the other carrying several Port Authority officials including Executive Director Arthur Yates, visited at Jamaica Bay in the two last Monday afternoon to discuss the San Juan takeoff that was finally carried because of the weather.

Tailoff nose thrusts gradually will be made at maximum 25 and 31 in

from the beginning of tailoff roll. Landings also will be checked, but there is no jet program for the 707 as there was for the Comet last month. Commit was at New York only for a day of testing, whereas the 707 program can be observed over several weeks by the noise experts.

The Port Authority tested the Caravelle for noise at Penn and the Comet for noise at London, and approved each for discontinuation flights into Idlewild. The Caravelle came into New York last year and now then cleared for full operation. The Comet came in for the time last month and results of Port Authority tests have not yet been announced, although full clearance is expected.

The agency had not announced its

conclusion from noise tests of the Boeing 707 at Seattle at the time it granted Pan American permission to serve into Idlewild for the tests, although in the case of the other jets it had announced preliminary findings before the planes checked out at the airport. Inquiries concerning 707 Seattle tests were held by the Port Authority on the grounds that final fullload tests had not been made and would be the determining factor. These tests were held in July last Port Authority will not evaluate them publicly.

The British Ministry announced at last week latest preliminary noise suppression restrictions on the operation of jet aircraft at British airports—restriction which could affect the economic capacity of the aircraft. These

Pan American-National Discuss Lease Plan

London operation might involve last work on a proposed agreement between Pan American World Airways and National Airlines for the leasing of jet equipment and an exchange of stock. Besides that the move was a last step toward merger was generally described by most airline officials but strong criticism was given to speculation that Pan American plans to gain a long-term foothold in domestic markets through the arrangement.

Generally used industry leaders like the transaction was planned to prevent such merger to share in new earnings that might result from an interchange agreement.

A Pan American official confirmed to Aviation Week that the transaction was in the making but would not release as the stage of the move all plan. Specifically, the lease arrangement would power National to operate Pan American's 707 jet transports on its New York-Boston line, the route as announced last in connection with Pan American's transatlantic service. Later National will have its DC-8s to Pan American for domestic transatlantic operations.

The proposed stock trade involves an exchange of 100,000 shares of stock between the two companies. Obviously such an exchange will call for Civil Aeronautics Board approval if the number of shares represents a substantial vote in either stock price. But there is a possibility that the stock will be sold in a new voting trust as a means of combining to fund sales.

AIRLINE OBSERVER

► American Airlines and Pan American World Airways are considering a through interline transatlantic flight as a provision to discontinue the special airport service when Boeing 707 jet transports are phased into service. Presumably that such a flight would originate in New York, fly direct to Los Angeles with a stop and crew change at New York. If the plan cannot be worked out, coordinated connecting schedules can be expected.

► Piedmont has pulled out its 720s E-27 turboprop transport scheduled for September delivery to America. Vectors on online. Production of the aircraft is now running at a rate of five per month. Next four E-27s coming off the production line are earmarked for America, Northern Consolidated Airlines, West Coast Airlines and Piedmont Airlines, in order of that proposed delivery schedule.

► International Civil Aviation Organization has warned that Russian-built transports may pose a serious competitive threat to manufacturers in the West. In a study of the economic implications of jet aircraft, the group said technical development of aircraft in Russia appears to be "most in line parallel to that in Europe and North America" and added that if Soviet planes were allowed "for sale in equality and at attractive prices" they could have a profound effect on the economics of world air transport.

► Aeroflot reports that a multi-engine Soviet commercial transport leaves Moscow on an average of every five minutes from either Vnukovo or Bykovo airports—the city's two major fields. The total of around 280 departures daily indicates that Aeroflot has more than doubled the frequency of Moscow's air service in the past three years.

► International Air Transport Association reports a 22.1 point decline in load factors during April, May and June on North Atlantic routes despite a 24.0% increase in the number of seating passengers over the same period last year. Seat capacity, however, jumped 49.5% during the three-month period and the number of scheduled flights increased 54.1%.

► Pacific Air Lines test of its Fairchild F-27 turboprop transport is being planned for a 44-seat configuration as a result of modifications designed by Pacific and approved by Fairchild. The aircraft is outstanding that cost per seat mile of the aircraft on the 40-seat, single-seater between San Francisco and Los Angeles will be "no more than the DC-7," resulting in substantially lower costs per seat mile.

► Civil Aeronautics Board Bureau of Safety is now conducting an overall review of standards for airline pilot training programs.

► All France will double service its service into Egypt for the first time since the November, 1956, British-French invasion of the Suez Canal area (AW Feb. 18, 1956, p. 13). The assumption of service is surely possible in a cultural and economic relations agreement signed last week by Egypt and France.

► British Overseas Airways is setting its fleet of 10 Elizabethan passenger transport aircraft manufactured by Alpkamp Aukland to make way for an all-transport fleet of Viscount Viscounts (700s and 503s) (AW Feb. 4, 1957, p. 18). The airline expects delivery of a fleet of Viscount Viscount transports and Conquest 40 turboprops in 1960. Company also plans to buy 24 de Havilland 125 turboprops for delivery between 1964 and 1966.

► De Havilland Conquest 40, development aircraft for the Conquest 40, has completed its first flight. The 10 has been modified to approximate Conquest 40 configuration by a 7 ft. reduction in wing span and will be used in development tests for the 40 which is now in production.

► Alaska Airlines is petitioning the Civil Aeronautics Board for an extension of its route between Fairbanks and Portland, Seattle and Tacoma to San Francisco and Los Angeles with an intermediate stop at Las Vegas, Nev.

SHORTLINES

► Transient Airlines reports a loss of \$211,551 for the first six months of 1958, as compared with earnings of \$40,125 in the same period last year. Arthur D. Lewis, president of the airline, attributed the loss to a four and one-half month strike by night workers which ended June 8. Hawaiian's passenger traffic fell 15% below the same period of 1957.

► Líneas Aéreas de California, S. A., has received permission from Mexico's Transportes Secretariat to operate its first route from Mexico City to Tijuana, over the California border of the U. S. The company is using C-46s for cargo and passenger service. Officials say, if the new route is successful, the company may buy more modern equipment.

► Los Angeles International Airport is expected to handle 2,527,781 arrivals and departures during the first six months of 1958, as 34% gain over the same period last year. International travel accounted for 165,511 passengers, a 14% increase over 1957. Airport officials predicted the full 1958 passenger total would reach five million as the majority of vacation and holiday travel takes place during the second half of the year.

► New York International Airport has announced the award of a \$149,099 1A contract to the Times Construction Co. for the pouring of concrete slabs. Purpose of this paving is to protect overhead expansion of the jet transports from picking up foreign matter when taking.

► Pan American World Airways says 39% more American took the airline's smoothest world flights in July of this year than in July, 1957. The airline said it served 5,215 passengers to Europe in the first week of July.

► Sabena, Belgian World Airlines and the American Branch Lines subsidiary company have entered into an aircraft purchase agreement by which American company may sell transportation over the other's transatlantic routes. Passengers may, for instance, fly to one of the 104 cities served by Sabena and return to New York, via American Branch's 18,000-ton liner, the Adriatic.

► Trans California Airways has entered a new \$2 million maintenance and overhaul contract to Lockheed Aircraft Service International. The TCA's fleet of Douglas DC-6Bs and DC-4s aircraft will be handled at the New York International Airport base of Lockheed.



Capt. George Miller, owner of 52,000 hours in Continental, looks for new Viscount 810 in the plane that is now in flight. He says he's not sure.

FAST, SMOOTH, EASY TO HANDLE... CONTINENTAL'S NEW VISCOUNTS

"This new Viscount 810 handles like a dream," says Capt. George Miller, Chief Pilot for Continental Air Lines. "The Pilot-By-Design 810 is a very easy aircraft to fly. Take-off and climb performance are outstanding. The Viscount behaves beautifully in any situation, and can be taken up to 10,000 ft. in a matter of minutes—very in fact. This powerful engine requires no warming up at ground level. They can be speeded up in one

in the dip in ready on the runway. Acceleration is smooth and fast. Control response is sharp. Take-off and climb performance are outstanding. The Viscount behaves beautifully in any situation, and can be taken up to 10,000 ft. in a matter of minutes—very in fact. This powerful engine requires no warming up at ground level. They can be speeded up in one

straight-ahead with smooth and efficient climb in mind. Window area is large, visibility excellent. Instruments and controls are grouped logically. The adjustable seats are especially comfortable. It all adds up to more enjoyable flying. This new Pilot-By-Design Viscount 810 is the best thing that's happened to pilot-passenger-in many a year."

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Today's Alloys Adequate for Missile Skins

By Michael Yaffee

Columbus, Ohio—Lock of temperature-resistant adhesive materials is not hampering U.S. missile development. Moreover, present materials will be used extensively in at least one more generation of missiles.

That is one of the conclusions in a newly issued Raytheon study. In its study memorandum on "Material Usage for Missile Airframe Structures," prepared by Dr. George Conrad, assistant director of research, New York University College of Engineering, and S. A. Gordon, consultant to Raytheon, the study goes into the matter of material selection for missile skins and contains much information that will be of value to the licensed missile designer who is being assisted by a fast increasing legion of civilian/defense contractors.

Expert Details

Other points in the Raytheon report are:

- With one exception, no ballistic missile is date—including new ones and proposed—uses a metal that can be considered "temperature resistant."
- Selection of materials for airframe structures is governed by the same design criteria as for manned aircraft, except for many characteristics and conditions, and is not hampered by high temperature considerations.
- No gross-to-tensile, or to gross or to tensile stress, either in operation or under development, can a material withstand such high temperatures.
- Because of the low-density nature of most missile airframes, an increased materials such as magnesium and aluminum have the weight advantage over titanium and aluminum steel up to 800° when the critical design stress is compression.
- Although the atomic and thermal expansion of a long range ballistic missile account for less than 10% of loss of gross weight, air resistance in weight of these parts will be well rounded in increased range.
- Use of high temperature materials in future ballistic missiles will depend on future philosophy. Thick low density material which serves as a heat sink can be used in place of a thin temperature-resistant material with little effect on missile performance.
- Increases in the strength of steel and titanium alloys will probably not change these conclusions. At the same time,

however, the appearance of a high strength, low cost, weldable titanium alloy might be cause for revision.

Since the writing of the memorandum a new titanium alloy has appeared—Graville. Steel Co. of America's B-120VCA. Dr. Conrad considers it a significant development and believes the alloy will play a major role in the design and construction of future high speed vehicles.

The first aircraft titanium structure, B-120VCA is composed of 71% titanium, 11% vanadium, 11% niobium and 1% aluminum. The new alloy, according to Gracible Steel, has a strength-to-weight advantage over high temperature steel and other titanium alloys up to at least 1,000° in short time up to two months—static tests and up to at least 600° in 100-hr tests. At 1,000° B-120VCA has an ultimate strength of 105,000 psi, a yield strength of 94,000 psi and an elongation of 37%. The material is reported to be highly formable and weldable. Gracible is now in pilot production on sheet products but has not yet established any prices for the new alloy.

Although the high temperature properties of B-120VCA compare favorably with those of such high temperature steels as 17-2PH, 17-4PH and AM150, the availability and eventual price of the new titanium alloy will prove most important in determining the value of

the alloy in a missile airframe structure. As Gracible and Gordon point out in their memorandum, titanium and magnesium still serve as the most efficient adhesive materials at present operating temperatures (up to 600°).

Bringing 10% in the standard page Conrad and Gordon calculated, these temperature features of steel, titanium, aluminum and magnesium involved. They found that the steel and titanium cylinders riveted with aluminum rivets permit and that the aluminum and magnesium cylinders riveted with aluminum rivets permit the same level.

Skin Temperatures

But in increasing the thickness of the aluminum and magnesium cylinders to a point where they still weighed less than 0.5% of the steel cylinders, the temperatures of the aluminum and magnesium skins dropped below that of the steel (in wall) in the equivalent weight titanium skin and steel wall within the same range.

The skin of the Atlas intercontinental ballistic missile is covered by Alcoa's Alclad, a temperature resistant special grade of stainless steel supplied to Convair by Washington Steel Corp. of Washington, Pa.

A number of engineers and metal buyers believe that it was unnecessary to go to a high temperature stainless at this stage of missile development and



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For complete information on SPS fasteners, write Aeroquip Division, Rockwell International Corp., 2000 S. Main St., Pomona, Calif. 91768.

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Dual Spectrum Rocket Engines

Pratt & Whitney's dual-spectrum rocket engines are available in two versions: the Pratt & Whitney dual-spectrum rocket engine and the Pratt & Whitney dual-spectrum rocket engine. The Pratt & Whitney dual-spectrum rocket engine is available in two versions: the Pratt & Whitney dual-spectrum rocket engine and the Pratt & Whitney dual-spectrum rocket engine.

some of them are beset with the usual as well. The release of the 1999 ICBM is now planned to be made of some material that is not too much resistant, reliable, dangerous.

Many of today's models also are steel in the section between the nose cone and the nose ribbing hole. Some might be steel here but going to titanium. Gravel and Gaudin is, and this is one being considered for some models under development.

Other area is a rivet where the vibration of titanium for steel will result in important weight savings in the piping for the propellant and the smaller holes containing pyrotechnic

In addition to weight, titanium alloys have the advantage over steel in corrosion resistance. Titanium has excellent corrosion resistance to most liquid fuels and oxidizers with the notable exception of red fuming nitric acid.

Although most of their study is devoted to the effects of shoreline vegetation, Wetzel and Noel, Girard and Landry feel it is necessary to include some discussion of herbivores.

The virtue of its high elastic modulus and low density (less than half that of metals) suggests to the other materials considered. Moreover, this agrees with some independence of beryllium's compressive yield strength which tends to act as an upper limit for its range of efficient applications.

Elasticity Modulus

High modulus of elasticity is more important than high tensile strength in a material because most tensile air frames are designed to carry low stress-level values. And for this reason, many tensile designers consider low-modulus, low-strength materials such as a low-modulus structural material class of strength below 55,000 psi at 500°

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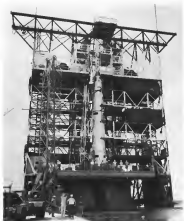
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Sliver missile badge depicting a rocket in space will be worn by U. S. Air Force officers and crew members assigned to missile programs. Design is worn under left blouse pocket flap.

In an attempt to relate structural requirements to the flight profiles of missiles in the ICBM and IRBM class, Curry and Gordon interviewed a number of manufacturers on structural solutions for missile airframes. They found that many factors influence the design of these airframes.

The most important consideration is minimum weight. Then, carrying out an extensive strength-weight trade on various materials, they conclude that on the basis of loading aluminum and magnesium are the most efficient materials at operating temperatures up to 300°C at low load indices.

Although composite materials is such a hot considered a prime requirement, materials require do want a work interaction is possible on the following thermal properties: specific heat, coefficient of thermal expansion, melting temperature, thermal conductivity, resistance and thermal diffusivity.

The elastic factors that influence material selection for aseptic sealants, according to the Böttcher report, are one of lubrication, corrosion resistance and its seal coat. Ease of fabrication generally leads down to weldability. Most of the sealant structure of a hollow sealant is an integral food tank and aseptic sealant is used so that it will be food tank.

ANALYTICAL INDEX, September 1, 1958

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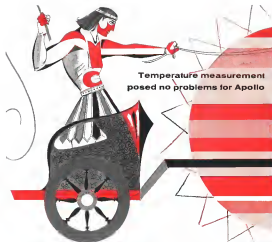
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when it is processed. Fabrication techniques such as abrasive forming and machining are of low importance in the manufacture of a rocket, maybe as low as in the production of a second airplane.

Again, since the surface is an integral part of the structure, it is important that both the surface and the structure be of uniform strength. Another important consideration here is the matter of extended storage. Do engineers consider magnesium as a reliable material, for example, for those missiles that will be subject to long periods of storage?

Quality of material is important as regard to pipe thickness, sheet thickness and uniformity of strength. Weight or requirements of these, are critical. If pipe thickness are broad or on the high side, there will be a weight penalty owing to the necessity of designing for maximum pipe. Similarly, uniformity of strength throughout the material allows the manufacturer to use the least amount of material to do the job. Sheet thickness is important because the ability to secure a leak-tight tank or other pressure vessel depends upon how well overlapping segments of the cylindrical structure fit together.

Cost is probably the most controversial factor involved in material selection. According to one source some space attack vehicles cost about one-fifth to one-third as much as manned aircraft vehicles. And for long range missiles, material cost is not considered too important.

On the other hand, for short range missiles, ground-to-ground and air-to-ground missiles, which generally require large quantities and are considered a major factor in material selection. But another company designer, at least in part, it doesn't believe that cost would deter manufacturers from selecting an expensive expensive material even for a short range missile if the material made a significant difference in performance.

Westinghouse Forms Weapon Study Group

David RBE, Jr., Westinghouse Electronic Corp. has formed an Advanced Systems Planning Group to study future weapons requirements and weapons actions according to Maj. Gen. Albert Band (USAF-Ret), vice president in charge of defense products.

Allen Chubb, branch chief engineer for the company's Aviation Gas Turbine Division, is director of the group. Other staff representatives include J. Dew (USN-Ret), executive member Navy assistant W. A. Davis, executive assistant, Air Force, and W. C. Robinson, executive assistant Department of Defense activities, and R. P. Krenn, chief engineer.



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Minor Changes Mark Latest Thunderbird

By David A. Anderton

Farnborough, England—Five new G. trials on English Electric's Thunderbird III, a jet-aerojet missile, point up the minor changes which converted last year's test vehicles to this year's production weapons.

Shown in its production form for the first time at the Society of British Aircraft Constructors' Flying Display and Exhibition here, the Thunderbird differs externally from early test vehicles only in detail. Production rounds are now being delivered to both British Army and Royal Air Force after an extensive and continuing test program which so far has seen several hundred rounds fired at Aldermorth in Wales and at the Woomera range in Australia.

English Electric points out that the growth potential of the weapon is substantial. One possibility is that of increasing the specific impulse of the missile's liquid chemical rocket motor's solid propellant sustainer.

Thunderbird can be broken down into major components for transport or can be stored and stored in a complete unit. External view of production rounds shows a series of circumferential cleaving rings at joints between major components, thus is one of the obvious features of the production design.

Missile Changes

Other changes in the production version from test vehicles include:

- **Control nozzles** substituted for the original set of test vehicles.
- **Elimination of leading wing and fin** design which showed on early rounds.
- **Addition of small lifting fin** in the pitch phase to the maneuverable solid propellant sustainer. Development flights to check booster separation showed the need for these fins in order to make sure the tail of the booster didn't hit the missile body shell on separation.

Guidance system for Thunderbird ties in with standard carb. warning radio defenses. The missile system is semi-active, and the missile homes on radar pulses reflected from the target after transmission from a ground station.

Close timing of both Army and RAF personnel has begun at the English Electric Guided Weapons Division, and what the company calls a "considerable number" of technicians have completed the course.

Present size of the weapon design was to develop a simple unit-aerojet missile adaptable to both sea and air launch, of reasonable, and one capable of a maximum of range. It will ground support equipment in fully active, being or and ground transportable in

Thunderbird Dimensions

Length, with or without booster	20 ft.
Wing span	5 ft. 3 in.
Control fin span	5 ft. 3 in.
Body outer section diameter	1 ft. 9 in.
Wing leading-edge sweep-back	45 deg.

carrying sustainer vehicle or aircraft

Thunderbird missiles arrive at a field assembly and test point in a disassembled state. Composite body is in a weather-proof container much like the "can" used to package and transport turbojet engines. Wings, control fins and booster motor are transported separately.

Field Site

The field site is a standard British Army mobile building constructed of light framework and covered with weatherproof cloth. Size of the site can be increased to handle a large number of missiles.

Engines are placed on an assembly line for final check before and attachment of wings, fins and booster. Then the entire missile is placed in a trailer and moved out of the assembly area to another point where it is transferred to a special trailer that carries it to the launcher. The latter trailer, in contrast to the simple unit that bears the



MOBILE of Thunderbird field assembly and test point shows equipment from time earlier the missile is packaged until they roll off the line, ready for launch. All equipment, vehicles and buildings are coming British military type.

missile through assembly is a trailer trailer with standard truck wheels, easily moved forward and backward and the ability to be towed over rough roads at open country to the launching site. At the launching site, the missile is transferred from the launching trailer to the launcher itself, which is then prepared

for launch and is in a ready state for firing.

Responsibility for the development and production of the Thunderbird weapon system and the launch of missiles that goes along with it is held by the English Electric group of companies.



HOISTED to firing position, Thunderbird missile awaits remote firing signals from a control point. Five new antennas have been attached to control these signals and are.



LAUNCHER-LOADING trailer (foreground) transports missile from assembly and test point to a field launcher (far rear). Missile is transferred to the launcher at launching site.



Regulus II Loaded in Douglas C-124

Chosen Wright Regulus II, U. S. Navy anti-submarine guided missile, can be transported in a Douglas C-124. Tail section was removed from this Regulus II because it did not fold, later version has folding tail. Wings are folded below body into C-124 body and missile is hoisted in 40 days at a 45 deg. angle. Dolly is a specially designed four wheel unit. Both nose and dolly are pulled into the C-124 body by the aircraft's power winch and secured through tailhook points on the dolly, points on hoist to match C-124 dock hook. Loading time is about 1 hr. Air shipment is used only when a missile is needed on a basis of one of the Regulus II test sites.

Polaris Navigation Contract Awarded

Danvers, Calif.—Aeroflex Division of North American Aviation has been awarded \$6.7 million contract to design and fabricate navigation system for launching Polaris-type first ballistic missiles. System was originally developed for Air Force Navaho and was modified prior to Navy evaluation.

Navigation system utilizes gyro-aided inert platform which maintains angular orientation relative to earth regardless of launcher's yaw, pitch, roll or vibration and will automatically re-orient itself to maintain accurate three-way, zero-velocity, in terms of continuously available, precise position and velocity information.

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schematic cross-section of standard coupling



schematic cross-section of flush coupling

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Bendix's compact radar unit saves weight, space for airlines and makes easier maintenance. New Airborne Radar System — a new 1-chamber radar system — has been tested. It weighs only 25.7 pounds and completely housed in a 1/2-ATN package.

This new T/R unit, when used with the

new Bendix 58 inch dual-band antenna, reduces the total antenna equipment weight to 82 pounds (164 lb 12- and 58-inch antennas, total system weight is approximately 91 pounds).

Because of its lighter weight, smaller size, reduced power requirements, and increased performance, Bendix Weather Radar is recommended by FAIRCHILD

for installation in the F-27.

For further information, write Bendix Radio Division, Bendix Aviation Products, Bendix Building, 205 E. 42nd Street, New York 17, N. Y. Consult Company's Division of Canada, Ltd. Box 50, Downsview, Ontario.

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For the F-27, Fairchild's Service Division has developed a new Freon refrigeration system which continues to cool the aircraft even when it stands on the airport with the engines shut down. No ground service, other than electrical power, is necessary. The air conditioning and pressurization system—for which Stratots has full design responsibility—will provide a comfortable cabin under any conditions, from a sun-baked Las Vegas airport to the cold of a Quebec winter.

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The Stratots Company for the
F-27's Freon air conditioning system





HSS-2 HOOVER has main blades folded, and main wheels retracted into outboard position. Two weapon racks are fitted on tailboom.

Sikorsky Unveils Twin-Turbine HSS-2

Stratford, Conn.—Monkey of its twin turbine-powered amphibious helicopter, designed to meet U. S. Navy aquatic needs for improved aircraft and deck support in anti-submarine warfare, was unveiled here last week by Sikorsky Division of United Aircraft Corp. Designated HSS-2, the helicopter design is aimed at outdoing existing Soviet amphibious warfare capabilities.

HSS-2, designed to supplement the current Sikorsky HSS-1 as Navy's main heli for one self-landing helicopter, lifts between it and the two-engine HUS-1 in size and capacity. HUS-1 Marine Corps search transport version will be

capable of carrying between 24 and 30 equipped troops. It will be fitted with a cargo sling capable of hoisting 6,000 lb. and a hoist for rescue which can lift 500 lb. Also in the design stage is a mid transport model, designated S-61, capable of hoisting 25 passengers.

Twin-turbine conventional S-61 is planned for operational service in the 1960-1965 period and is aimed to provide rescue with DC-type capability in the rotary wing field, having sufficient payload combined with medium gas performance to meet a trend of currently heavily subsonic aircraft.

First HSS-2, now under construction,

is expected to make its first flight at Sikorsky's Stratford, Conn., plant in 1959. Basic configuration and details are shown in these first pictures of the full-scale model.

Designed to meet requirements for both deck and ship-based operations, the HSS-2's universal landing gear is composed of a fixed base-type hull bottom, two outboard pontoons into which dual main wheels can retract and a fixed tail wheel. Similar configuration as on the Sikorsky S-61 amphibious amphibians, which has been flying since May (AV Aug. 23, p. 64).

That, developed using Sikorsky's con-



LARGE SLIDING DOOR, behind pontoon, uses hoisting. Hoist (over door) has 600 lb. capacity. Cargo sling can hold up to 6,000 lb.

ventional gas-turbine World War II engine, but engine, is developed at a lower weight increase than would be required using suitable gas-turbine engine. Landing is designed to provide a compact configuration with folding main rotor blades, to provide one of strongest and heaviest about anti-submarine close aircraft carrier.

Two engines are two General Electric T58-GC-6 light-turbine, 2,000-shp afterburner mounted side by side above the cabin, close to the main rotor to minimize coupling problems and carry of foreign objects. Airframe portions and details are well described. The HSS-2 is designed to attain 160 mph in a single engine.

Added Capabilities

Combination of two turbines with amphibious configuration will provide the Navy with an opportunity for studying new techniques to conduct anti-submarine warfare program among the new capabilities provided by the HSS-2 will be:

- Ability to alight on water during water dipping operations, enhancing sound helicopter endurance in a cross-seaable manner. Showing basic of water surface, will permit reduction of engine power, compared with present hovering technique, and also permit important savings in fuel to extend range and reduction of pilot fatigue.
- Work on water, water operations can easily be conducted to greater depth than are possible with fixed-wing aircraft, allowing from hovering helicopter to the water surface. Need for landing gear depth was pointed out in recent coverage of Link Force ALFA (AV July 21, p. 77).
- Greater payload capability provided by main rotor, certification will permit carrying considerably more electronic equipment needed for hunting and tracking underwater vessels and most, and heavier weapons to destroy them. New standard HSS-1 can carry two M-45 launch missiles. HSS-2 will be fitted with four racks and will have nuclear weapon capability.

Twin T58 installation has been light-weighted for more than a year in a modified HSS-1 testbed. Installation of the engines centered instead of in the wing, as on the HSS-1 test vehicle, permits improved stability, forward and downward for pitch. Rotor arms will be provided by the engines by use of large joints that hinge downwards to provide platform and low forward.

Main rotor system composed of three-bladed rotor which will be retractable, not only moving such other light loss on HSS-2 to aircraft. Conventional rotor system has been used to increase the rotor pitch and rotor head to improve performance. Flight



CLAMSHELL DOORS provide entrance to cockpit. Hoist platform drop hoisting cable into hoisting mounted T58-GC-6 turbine easily accessible for maintenance and checks.

test work in this connection has been done using an HSS-1. Main and tail rotor blades utilize retractable clamshell doors.

Sikorsky reports that the HSS-2 is offering a number of equipment already used in previous helicopters. This design philosophy is intended to lower both initial and operating costs by re-

ducing number of new items needed in the parts inventory.

HSS-2 will be fitted with acoustic navigation equipment equipped with Doppler system to provide Navy helicopter ASW units with all-weather operational capability. Equipment will include possible automatic light during low-visibility hovering maneuvers.



CABIN (looking aft) has high density ceiling, 25-30 ft. diameter, which will give open hoisting vision designated HSS-2. Can S-61 can take up to 25 passengers.

The black box that guides a man or missile

...without stars, radar or human help

Imagine yourself in a closed elevator hurtling through space at several times the speed of sound. You can't see out. You have no radio, no compass. Yet your survival may depend on knowing exactly where you are during every second of the journey.

This gives you some idea of the situation that confronted aerospace engineers in the development of the all-weather cruise/interceptor. Unlike earlier navigation systems, it does not depend on star-fixes, compass bearings, radio, or radio beacons; its accuracy cannot be affected by weather, magnetic storms, or jamming.

Sealed in its "black box," the all-weather interceptor is completely self-sufficient. Just tell it the starting point and the destination—and it will take you wherever you want to go. Rapidly accurate, it will tell you exactly where you are at any given moment.

This new navigator will be a vital part of America's manned and unmanned weapon systems—a valuable tool for ships and submarines. And it has brought the exploration of Outer Space much closer to reality.

Space Age pioneers

This remarkable invention was first demonstrated successfully, way back in May, 1953, by the Autonomic Division of North American. It is based on a system known as Inertial Navigation, which Autenticine brought to perfection through intensive research, new methods of precision manufacturing, and more than 800 flight tests in both manned aircraft and missiles.

The first missile to be guided by inertial navigation was the Navaho, developed by Stande Division. Aerodynamic and propulsion-system data from the 12-year Navaho program have been of immense value to America's missile programs. The division is now working on the GAM-77, a jet-powered air-to-surface missile that will give new striking power to the Air Force B-52.

North America's pioneering paid off when the Army launched its Explorer satellites. For the rocket engines that drive the Jupiter "C" missiles their first-stage boost into Outer Space were the same model that has been in production at the Rocketdyne Division since 1953, slightly modified to burn a new high-energy fuel recently perfected by Rocketdyne's engineers. Rocketdyne engines power the Air Force Atlas and Titan, and the Army Jupiter and Redstone.

The new manned weapon systems

NAA has turned its experience with aerospace aircraft, proven in the First World, to creating new manned aircraft for tomorrow's Air Force and Navy. The Los Angeles Division is at work on the B-70, a 2,000 mph bomber with global range, and the F-108 long-range interceptor—both for the Air Force. The Columbus Division is building the AJF Vigilante carrier-based attack weapon system for the Navy.

And North America is building the first American craft to attempt manned flight in space—the rocket-



Titanic Test Flight. The 2000 mph Navaho pioneered America's missile technology. Missile Division is now at work on the advanced GAM-77 for the Air Force B-52.



New Supersonic Bomber. The carrier-based AJF Vigilante, recently arrived by Columbus Division, gives the Navy its first supersonic attack weapon system.

powered X-15—for a scientific project sponsored by the National Advisory Committee for Aeronautics, the Air Force, and the Navy.

Nuclear reactors for peace

North America has pioneered in creative uses of the Powerful Atom. The Atomic International Division builds nuclear reactors, to increase the world's resources of electrical

power and to advance medical and scientific research for humanity.

Today, in North America and its divisions, you'll find at least a cross-section of scientists, engineers, and production men as busy in American industry. Because they are constantly forging ahead into new technologies, much of their work builds immense pressure for science and industry.

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Los Angeles, Georgia Park, Swamp, California, Ohio, St. Louis, Missouri

Radar 'Skyhook'

Remotely-controlled, six-color television, designed to provide a platform for a 1,200-1,500-ft. antenna for anti-air and other warning systems, is being designed by Hughes Helicopters Co., Torrance City, Army Signal Corps, Ft. Monmouth, for an aircraft replacement for remote-controlled helicopter platform to perform this mission, also plan wide dissemination of this equipment among its numerous divisions to use for applications would fit in with their own systems.

Substantive as that a "vertical" type platform, will enable, enable of being mostly converted to handle any of a number of Signal Corps missions. Built in the futuristic style, tentative specifications for the 'Skyhook' would require that it maintain the antenna at approximately 7,500-ft. altitude for 160-220-sec. duration and have an reliable capability to maintain this endurance.

Night vision ground assignment designed around Electronic (EVS) products, will become the primary means, this rotor, may find supply and control means components show the top area to supply actual rotating and control problems.

Model, with disk loading being 30 lb/sq ft.

Upper rotor diameter of Model 190 is 11.72 ft. Blade chord is 0.75 in. No NACA 0015 section is planned with no front, the turbine-powered system would have flat-bottom blades. Upper rotor blades are fully articulated with a relatively large amount of flap hinge offset (7.5 in.) to provide large

radial control. When rotor goes to subrotation, an angled Alpha large provides automatic change of blade pitch to three degrees as the shaft stops rotating. Subrotation speed is approximately 500 rpm.

Steady engine in the upper rotor system at base of engine failure would restrict fuel flow of the helicopter during ground transition to subrotation, Nig for rotor.

Model 190 performance estimates include cruise speed of 65 kts. and maximum rate of climb of 180 fpm. Fuel capacity is planned at 252 gal and fuel consumption is estimated at 13 gph.

Gross weight of the piston-engine tripropeller is estimated at 1,750 lb and empty weight at 1,017 lb.

Lubrication

Lubrication of the Loosening 0160 is dry sump type oil flow through a return seal to the second engine oil pump at the end of the work row and is pumped through normal internal passages, is collected at the bottom of an oil sump. From here it is pumped through the oil and back to the engine. Fuel system is remote mounted type with carburetor on the fuselage frame. Air is collected through a rotary seal, with the oil seal serving as a hot spot in order to heat the fuel supply.

Fuselage is a steel tube structure, the tail boom being attached to three bolt turbine-powered rotors will mount the engine in a suspension yoke, which will absorb complete the main rotor head and of the fuselage. Fuselage chamber for the fuel skid is located under the cockpit floor.



KEY ENGINEERING OPENINGS AT YOUGH

ADVANCED WEAPONS

This Vought division is planning, analyzing and preparing new designs in missile and fighter weapon systems. New tactical requirements are established for new weapons, feasibility studies conducted, and proposals prepared.

Select openings exist in both the Advanced Missile Technical Group and the Advanced Aircraft Technical Group. These are responsible positions for engineering specialists and for design engineers up through lead level. Advancing the requirements for 4 openings which are typical of others in these groups.

Radio System Engineer or Specialist, A.E., or E.E. (M.S. preferred) with at least 2 years experience in systems and/or design for radio and fire control. To make high-level studies of advanced guidance and control systems.

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Advanced Weapons Engineer, A.E., E.E., or M.E. (M.S. desirable) able to develop methods for dynamic stability and substructure studies. To study, or design, methods for substructure, dynamic stability, attitude and extreme configuration, and to make static and dynamic stability studies. All in supersonic and hypersonic range.

To arrange for a personal interview, or for a prompt report on this or other current openings, please contact us.

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In minutes, Republic II can pierce over 1,000 miles of hostile sky to score a nuclear ball's eye.

The first of the Navy's nuclear-driven subs, designed to make this was its success Republic II boats, is now in construction. The missile itself has made over 25 successful flights. Under Navy leadership, it will be a relentless watchdog for peace.

Scientists and engineers pioneer with Vought in new missile, manned aircraft, and electronic programs. For details on career openings write to: C. A. Bink, Supervisor, Engineering Personnel, Dept. 16-5.

CHANCE **VOUGHT AIRCRAFT**
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Floats Installed on Mil-1 Helicopter

Floatequipped version of Mil-1 helicopter employs aircraft's conventional wheelbar landing gear for expanded amphibious use. Russian designer M. L. Mil sees many float-equipped Mil-1s will be built, some for Soviet whaling fleets. Single-engine Mil-1 is powered by 175 hp. Ash 208 radial engine, has 600 cu cu and 205 mph speed.





NOVEL vacuum tube with an extremely low noise figure, approaching that of a 10-ohm amplifier, can be used at VHF and microwave frequencies. Tube, developed by Zenith Radio Corp., has a right screwbase in turning over tube but uses different principles.

Low-Noise Tube May Boost Radar Range

By Philip J. Kline

Charge—Randomly low-noise high-gain vacuum tube for amplifying VHF, UHF and microwave frequencies, which couples a fundamentally new principle, has been developed here by Zenith Radio Corp. recently.

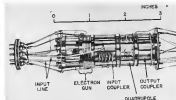
The new device, called a Fast-wave Transverse-field Parametric Amplifier, or Quadrupole Amplifier, holds promise of a major boost in sensitivity of radio-located radars.

Laboratory models which Zenith has built for operation at 940 mc reportedly exhibit noise figures below 1 db, gain of 50 db, and bandwidths of 100%. The tube is structurally stable and completely isolated, Zenith says. By use of compression, tracking wave radar operating in the same frequency range with compatible gain have noise figures of around 6 db.

Zenith's new tube has noise figures comparable to those obtainable with noise amplifiers, but without cooling apparatus required for some Maser.

With further development, still greater reduction in the noise figure and increase in bandwidth, perhaps to 20%, appear possible, according to Dr. Robert Adler, assistant director of research at Zenith. Adler developed the tube in cooperation with Dr. Glen West of Stanford University.

Quadrupole amplifier tube for 940 mc operation measures about four inches long, less than one inch in diameter. Thin films can be sealed down to frequencies perhaps as low as 100 mc, or up to several thousand



ELECTRON COUPLER (left) becomes an amplifier when a quadrupole structure is added to produce a rotating transverse magnetic field which sustains the orbit of electrons. The schematic drawing of a new Zenith low-noise amplifier (right) shows the electron beam, input-output couplers and the quadrupole structure.

frequencies, Dr. Adler believes. The theory suggests that noise and gain of new tube will be substantially independent of operating frequency and limited, essentially, by the noise of the input signal.

Zenith has produced low-noise models with and is now moving with initial sample tubes for trial use by component makers. The company plans to follow this with production design and full-scale manufacturing. At this stage, Zenith is not releasing figures on estimated selling price, but believes the tube will be relatively inexpensive to produce, according to Dr. Alexander Heller, Zenith vice president.

Zenith's new tube, like a conventional tracking wave tube, employs an electron beam. However, instead of using the slow space charge wave in the electron beam employed in the tracking wave tube, the Zenith tube utilizes



QUADRA electron coupler, which uses a fast wave in electron beam to transfer energy from input to load, demonstrates the basic principle of a new Zenith amplifier.

one of the fast wave which orbits around the electron beam.

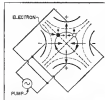
To explain the principle of operation, Dr. Adler begins with the Gauss electron coupler, device developed 10 years ago by a Radio Corp. of America engineer. It is an unbalanced device which employs an electron beam for coupling a signal to its load.

In the Gauss coupler, an electron beam passes between two loop-coil constant magnetic coils. One connects to the incoming signal, the other to the load. A steady state magnetic field (G) is applied along the run of the electron beam. This confines the beam and also causes the electrons to orbit around the lines of force at a frequency which is proportional to the strength of the applied magnetic field. Field strength is selected so that the orbital frequency, called "cyclotron frequency," is approximately equal to that of the input signal.

Outward Spiral

When a signal is applied to the first coil, or coupler, it produces a transverse field at right angles to the beam. This causes electrons to spiral outward, increasing their radius of orbit in proportion to the signal strength. For any given signal, electrons reach maximum orbit at this point the coupler. If the same signal the incoming signal energy is transferred to the electrons through an increase in their orbital kinetic energy.

When orbiting electrons pass through the second coupler they induce a radio wave in the circuit element to give up their orbital kinetic energy and



ELECTRON COUPLER (left) becomes an amplifier when a quadrupole structure is added to produce a rotating transverse magnetic field which sustains the orbit of electrons. The schematic drawing of a new Zenith low-noise amplifier (right) shows the electron beam, input-output couplers and the quadrupole structure.

spiral inward toward the center. If the output coupler produces suitable magnetic fields, electrons give up practically all of their orbital kinetic energy, effectively transferring the original input signal to the output load, but without amplification.

Any random motion of the electrons as they enter the first coupler, which represents noise, is transferred to this coupler and dissipated by means of a resistor, providing that it is a good one. Because noise, this "sucking out" of electron stream noise occurs simultaneously with the increasing of the input signal on the electron stream described above. The transfer of fast-wave noise from the electron stream is what gives the Zenith device its low-noise feature.

Gaining Amplification

To obtain amplification, two pairs of plates arranged in a quadrupole structure (similar to four poles of an α c. motor) are placed between the input and output coupler surrounding the electron beam.

An external microwave power source, or "pumping signal," similar to that used with Masers and newly developed microwave diode amplifiers (WV, Aug. 4, p. 68), is connected to the four poles so that adjacent poles are of opposite polarity.

Pumping power frequency is selected to be approximately twice the frequency of the input signal to be amplified. The quadrupole structure produces a transverse magnetic field which orbits around the electron beam at the same frequency as the orbital cyclotron frequency at which the electrons are rotating as they move along the length of the beam.

The rotating field effectively transfers energy from pumping power to the electron beam, causing them to speed further out at longer radii from the center

Since the strength of this rotating field is proportional to the distance from the center, and the electron orbit radius is proportional to input signal as it enters the rotating field, the new orbital distance which the electron stream traverses is proportional to the original input signal.

When electrons reach the second (output) coupler, they now have considerably more kinetic energy to transfer than they had when they left the first coupler.

That the output is an amplified version of the input signal.

Low Voltage

The tube operates at very low voltages to obtain reasonable number of cyclotron orbits in a short tube length. At 6 volts there are four orbits per centimeter. Perforated electron beams, which operate at 15 kilovolts, or 50% of the theoretical current density for the cross section and

Strength of the d.c. magnetic field required depends upon the frequency at which tube is to be operated. At approximately 200 Gauss are required at 100 mc, approximately 1,000 Gauss at frequency of 2,000 mc, according to Adler.



NOISE and noise levels for electron coupler are shown relative to beam diameter.

Gain depends upon the amount of pumping power required. Present tubes achieve about 25-30 db gain with pumping power of around 10 milliwatts.

Bandwidth of the tube is determined primarily by the design of input-output couplers and noise levels to prevent a good impedance match on the demand bandwidth. The same considerations are one of the basic factors in determining the upper limit of frequency for which any tube can be designed.

That theory indicates that with a perfect input coupler impedance match, the new Zenith tube noise figure should be about 0.6 db. However, from a practical standpoint after targets that have noise is being generated by secondary electrons and beam amplification as well as from lack of perfect impedance match in present experimental tubes.

We started with a 3 db noise figure and have now achieved figures below 1 db," Adler says. "Probably this is not the best that can be done."

Bell Telephone Studies Ferromagnetic Material

Material which exhibits diamagnetic properties at low temperatures but does not contain any of the common ferromagnetic elements has been discovered by Bell Telephone Laboratories. Material is a mixture now composed. At temperatures below 4K, material exhibits properties similar to conventional ferromagnetic materials, but with no magnetic moment. It was thought that ferromagnets could not exist in an unimolecular compound unless it contained at least one strong magnetic element. Discovery, by B. T. Matthias, provides powerful new tool for study of fundamental characteristics of magnetic and magnetic materials, according to the company.

NEW AVIONIC PRODUCTS

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• **Micro-miniature relays, in voltage-sensitive or current-sensitive types, for**



printed circuit application, operate over temperature range of -65°C to 125°C respectively meet MIL-R-17757C. Voltage sensitive unit, Model K794 requires 150 mw. operating power; current sensitive Model K709 requires 230 mw. Relay comes in double-pole model, with contacts rated for 2 amp resistive load at 25 v d.c. or 115 v a.c. Unit weighs approximately 4.94 x 3.41 x 2.075 in. or 1.187 oz., depending upon model. Ives Flammable Mfg. Co., Electronics Division, 2835 S.E. 9th Ave., Portland 2, Ore.

• **Water-cooled pressure transducer.** Model P749, for use in rocket engine tests, will withstand gaseous media



temperatures above 5,000° when run with cooling water. Unit is available to measure pressures up to 2,000 psi, has non-linearity of 1% of full scale, hysteresis of 1% of full scale. Dynamic Instruments Co., Inc., 28 Colburn St., Cambridge 42, Mass.

AVIATION WEEK, September 3, 1959



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The Model 7-100 combines up to four input data sources into a composite signal for recording on a single magnetic tape track. Provides visual monitoring of individual inputs, composite output, or recorder function.

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An Aeroengine full-fueling four-bladed turbine provides all the power needed for pumps and reels in the self-contained "Buddy Store" that turns fighters or attack bombers into aerial tankers in eight seconds. This first successful run air-powered tanker kit is lighter and more streamlined—needs no plumbing or power from the tanker plane.



COOL PERFORMER FOR HOT JOBS



Proved in severe tests from ambient to 1000°F, the new Aeroengine high-temperature linear hydraulic actuator makes dependable operation of thrust spools and thrust reversers possible. Now being supplied to Marquardt Aircraft Company for incorporation in a complete reverser system, its patented fluid flow and seal system removes heat rapidly and continuously—provides positive seal—ensures smooth, dependable operation. Patented synchronization system permits multipoint installation. If required, a patented self-locking feature automatically holds reverser or spool in fixed position if power fails.



Little things that mean a lot to Jet-Age Progress



BEATS THE ICE BARRIER

New Aeroengine ICEFOIL is specially designed for installation in gas turbine intake duct—activates de-icing systems at speeds from 50 to 500 knots—meets requirements of MIL-D-8181 plus 2000 cps @ 150 Vibration Test plus 1450 lb-ft. ice-ball impact. Test: In excessive wind tunnel tests, the ice/ice cycle time varied only 3%.

The four examples shown here—with tops in its field—are only a part of the Aeroengine story. Aeroengine proved design ingenuity and production know-how are now spending the solution to many "unsolvable" airborne accessory problems on commercial and military aircraft and on missiles and rockets. Aeroengine engineers are ready today to consult on your project—classified or unclassified. Write.

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ALLISON DIVISION OF GENERAL MOTORS, DAYTON, OHIO



HEAVYWEIGHT POWER FROM A LIGHTWEIGHT PACKAGE

This air-driven generator weighs only 22 pounds—delivers 1.7 KVA for the Navy's A4D carrier-based bomber, is scheduled for later versions of the A3D. It has the highest power-to-weight ratio of any unit of its type—uses a simple blade pitch-changing mechanism to get up to speed in less than 1/10th second.



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Fewer May Share Helicopter's Future

The companies can't afford to rest on the laurels they have gathered so far, however. They will be herding their efforts toward increasing payload and

Stanley also holds the post of



Sea King F 151, a five-ton green and purple helicopter, has made its first flight at a company's Eastleigh plant and now is undergoing tests. Built as a private venture, the F151 can be converted to an ambulance by replacing triple sea and two twin engines. Aircraft is powered by a BAE/Bell Turco 606 two turbine engine rated at 621 shp. Cruise speed is 200 kt and maximum endurance is 5.2 hr. New helicopter can be fitted with hoist for rescue operations. Gross weight is 3,000 lb.



Tactair 1000 Selector Valve, a pneumatic solenoid-operated unit for air-to-air missiles, contains four 3-way valves in one, provides precision flow control, rapid response.

Memo: to missile men looking for dependable components

Meeting strict critical valve requirements to assure dependable demands a rare combination of creative engineering and specialized manufacturing skills. To date, none but Tactair precision equipment, rapid quality control and long experience with aircraft and missile components. Tactair has all of these essentials!

Case in point: the Tactair solenoid actuated, precision multiple selector valve with precision flow control—specifically designed and built for high dependability in a new aerospace missile. This valve is unusual in that it contains four 3-way valves in one. Precision flow control is applied individually and independently to each of the four 3-way units.

Result: a high order of dependability under extreme environmental and operating conditions. Unique design gives accurate control of flow over a wide range of pressure—from 500 to 3000 psi. Controlled response is extremely rapid—50 milliseconds. Valve is very compact and light in weight for a complex unit of this type—only 2.6 pounds.

Remember: an standard or special component, we welcome the opportunity of assisting you with your most precise valve problem. Every job we do is done as a precision item, it has been that way for 56 years. Tactair Valve Division, Aircraft Products Company, Bridgeport, Pa. BRD-3000



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contracts, and prospects aren't as bright there.

Current military competition for a three-ton class helicopter is the only one in the works right now, and it doesn't look as if there will be a large amount of competition to follow. Civilian products that the military will generally find itself in need of to replace old service models.

Commercial Market

Relatively slow pickup in the military markets have caused interest in the much smaller commercial market, and the competitive design has stepped up in the past year or so.

Vertical lift seemed to be on the large transport helicopter market once completely dominated by Sikorski, and Bell has recognized its sales effort in a campaign to expand commercial sales. Observers at the Helicopter Assoc. of America convention last January saw sales companies competing for the favor of commercial operators.

The commercial market has been slighted somewhat this year by the recession, but the industry expects it to grow as part of the total market. Improvements in the controls and increasing public acceptance are viewed as keys to this growth. Another key factor is the need for rotor helicopters in metropolitan areas.

The market will also expand as business finds more uses for helicopters. This applies to the military market too as *illustration* is the experimental work now being done at Ft. Rucker to see whether helicopters can be engaged and engaged as aerial cavalry.

Varying Opportunities

Charles H. Kossow, president of Kossow Aircraft Corp., told Aviation Week that "movement of us in the helicopter industry is in a position to participate in a next new era." There are approximately 10 production companies now in the United States and a like number in Europe.

While all these companies have a chance to share the industry's future, it is not likely that all of them will be able to do so.

Chances are all these companies will not be able to hold out until the market expands.

Conservative estimates that the present market can support four or five companies, and he feels that there will probably be room for a couple of models in each class of helicopter.

McNair figures that even so, future growth the market will really support only three or four companies. The figure is somewhat on how much companies have military policy ways to maintain in the industry, but there are increasing doubts about just how much competi-

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[illegible]

Benjamin says Vertell is not making a

Some companies become devoted to a certain patent technology, as they try to improve their products. A capability in electronics would have to be acquired, for instance, in order to develop autonomous living capability for helicopters. But much of the development going on today goes far beyond that limited area.




Kaiser "Living Table" vertical table (eg. *AM*, Aug. 11, p. 71) now in 210 E. as first public demonstration at Fashion Square. Offer is buy-one-get-one.

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Standard Precision Steel Co., Jenkintown, Pa.



Thiessen model PDTP 001 camera is 14 in. thick, 34 in. in height and 7 1/2 in. in depth. Weight without lens or film is 4.4 lb. Operating speeds are 16, 24, 32 or 64 frames per sec. Camera is said to operate under the following environmental conditions: 25G acceleration on three axes only, vibration of 18 to 50 cps at .006 in. and 50 to 180 cps at .001 in.; 100,000 ft. altitude, temperatures from -65 to +150F.

Fuehrle Data Design Corp., 884 Midland Ave., Yonkers, N. Y.

Forged Lock Nuts

Cold-chamber cast nuts for aircraft and panel assemblies are said to be



lighter in weight, yet just as strong as sheet metal (NAS-671) and AN-series nuts. After steel nuts, with external swarfing, have been there are now made in cast Na + through 1 to Manufacturer says larger sizes will be added later.

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Flexseal Corp., 1315 S. 3rd Ave., Maywood, Ill.

Ablation Meter

Meter is designed to measure the amount of ablation of a solid test case during reentry into the earth's atmosphere. Developed for the Aero Ballistic Missile Agency, the instrument is said to be capable of measuring the condition of entrance walls of blunt bodies.

Refractant consists of two parts, a constitution detector probe, and an electronic counting rate meter circuit. Meter is designed to withstand shocks of 40Gs and vibration of 2,000 cps at 100Cs. Unit may be used in conjunction with an indicating meter, strip chart recorder, voltage controlled recorder or a television vision Acceptor in 5% or better, the meter itself.

Cook Research Laboratories, Norton Grove, Ill.

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Barometric altitude controller is designed to maintain an aircraft at a constant barometric altitude. Controller's operating range is from -1,000 ft. to +10,000 ft.

Transmitted unit is accurate to ± 20 ft. at sea level and ± 25 ft. at 10,000 ft. Altitude controller is employed in fixed altitude flying and automatic landing operations, the latter strictly.

Servomechanisms, Inc., 12100 Aviation Blvd., Hawthorne, Calif.

Jet Blast Fence

Jet Blast fence, designed for Boeing 747 and Douglas DC-8, is constructed of spaced corrugated steel panels supported by a galvanized structural framework.

Fence is designed to diffuse the blast by directing it upward through the fence openings. Design is said to eliminate upward air flow, preventing use of lightweight concrete bearings. Price



is quoted as \$12 per linear foot and installation costs average \$4.50 per foot, the maker states. Aircraft in photo is Boeing KC-135.

Loan Engineering Co., Box 960, San Francisco 4, Calif.

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Moore Products Inc., 740 Washington Ave. North, Minneapolis 1, Minn.

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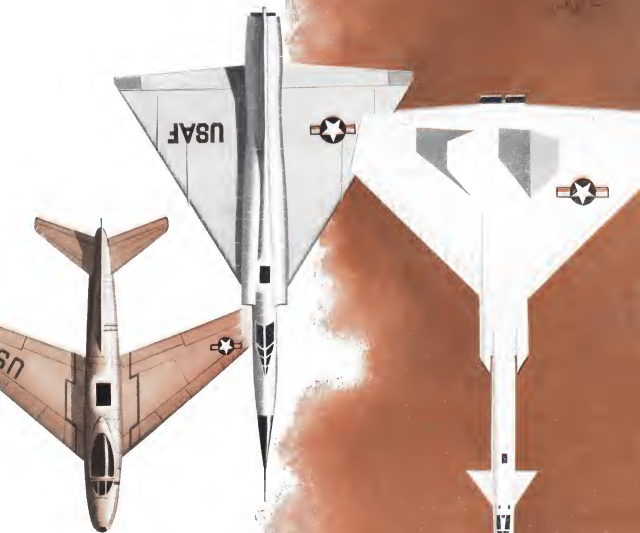
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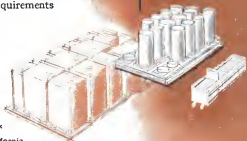


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